

efficiency," based on review of the relevant literature and first-hand observations. The affidavits further attest that:

Deployment of SDMA technology will substantially reduce the amount of radiated (RF) power (over current technologies) required, per link, to establish reliable communication through directional transmission from and directional transmission by base stations, and will allow multiple wireless links to share the same spectrum in the same cell.

The attached affidavits verify the benefits of SDMA technology, which include lower power handsets and base station RF transmissions.^{21/}

In SCI's Technical Appendix, appended to its May 4, 1992 preference request, SCI presented the results of computer simulations indicating the ability of SDMA technology to increase PCS capacity and quality.^{22/} The Appendix also provided preliminary experimental results, including tests run in a controlled RF environment (anechoic chamber).^{23/} These experiments demonstrated the ability of SDMA to localize three co-channel sources in close proximity with varying power levels.

The Technical Appendix outlined a two-year experimental plan, culminating in final system certification and mass

^{21/} The affidavits were prepared by Dennis Rucker, Director of Engineering, and George Geotsalitis, Manager, PCS Standards, of U.S. Cellular Corp.; Stuart Jeffrey, Vice President of Engineering, Kycom; Guy Jouannelle, Senior Engineer of LCCLLC. See also Engineering Statement and Declaration of Robert A. Voss, appended to December 8, 1993 Petition for Partial Reconsideration of MCI, which comments favorably on SCI's smart antenna technology.

^{22/} SCI Request for Pioneer's Preference, Appendix A at 27-31.

^{23/} Id. at 31-38.

production and installation of SDMA technology base stations in fully operational PCNs. Pursuant to that plan, further testing of SDMA technology was undertaken between May 1992 - August 1993. The results of this testing were detailed in a September 13, 1993 filing with the Commission.^{24/}

As more fully described therein, the experimental program used SDMA prototype equipment, developed by ArrayComm, SCI's parent company. The results of initial SDMA experimentation verified an improvement in signal quality approximately equal to the theoretical gain. Additional experiments demonstrated SDMA's ability to spatially demultiplex and improve multiple waveforms, and to directively transmit to specific users. These experiments demonstrated that, through use of SDMA technology, substantial increases in spectral efficiency can be achieved - through power reductions in base station transmit power levels and increases in coverage area. A videotape was also submitted which included footage of the experiments being conducted.^{25/}

These submissions clearly demonstrate SDMA's technical feasibility. While the September 1993 test results support SCI's claims, it bears emphasis that, even without the field testing, SCI's showing of technical feasibility complied fully with the FCC's rules. The Commission has never required a showing of technical feasibility in "an actual operating environment."

^{24/} See Exhibit D.

^{25/} The experimental results and videotape were submitted under File No. S-1193-EX-93 (Call Sign KS2XAG).

Even though operation under actual field conditions is not required, SCI has, in fact, successfully tested prototype SDMA equipment under such conditions.

IV.
THE COMMISSION'S PREFERENCE DECISION WAS
IMPROPERLY BASED ON AN INCOMPLETE RECORD

The Commission's decision, denying SCI's preference request, was improperly based on an incomplete record and is therefore fatally defective. Under well-established Commission precedent, the Commission should re-open the record, if and as necessary, to consider material information that was timely filed with the Commission, but not associated with SCI's pioneer's preference.

In denying SCI's preference request, the Commission lacked a critical piece of information: the experimental test results submitted in September 1993 by Dr. Roy. Although these results further demonstrated the feasibility of SDMA technology, this key information was not considered by the Commission in evaluating SCI's preference request.^{26/}

As discussed above, the experimental program discussed in the September 1993 test results involved prototype SDMA equipment operating under actual field conditions. This testing further confirmed the technical feasibility of SDMA technology and was

^{26/} The Commission has allowed applicants to supplement their preference claims after release of a Tentative Decision. See, e.g., First Report and Order, July 23, 1993, GEN Docket 90-314, 8 FCC Rcd 7162, 7174. The Commission there allowed Mtel to submit supplementary experimental data demonstrating the feasibility of its technology.

therefore directly relevant to the Commission's pioneer's preference determination. The failure to consider the experimental test results was highly prejudicial to SCI's rights, and requires reconsideration of the Commission's decision.^{27/}

This additional evidence of technical feasibility was not properly associated with the SCI preference request. In fact, the test results were submitted by Dr. Roy in File No. S-1193-EX-93 in connection with an experimental STA granted to ArrayComm. However, SCI should not be penalized for this inadvertent oversight. In reality, Dr. Roy's duties on behalf of SCI and ArrayComm, SCI's parent company, have a common goal: development and implementation of SDMA technology. Dr. Roy viewed the interests of the two commonly-owned companies as identical, and assumed that the Commission would take cognizance of the supplemental technical information relating to SDMA technology.

Throughout the past five years (and before), Dr. Roy has been focusing on technology development and on obtaining the necessary support to continue his pioneering work in SDMA

^{27/} See Iowa Radio Service, Inc., 61 RR 2d 292, 296 (1986). The failure of an Administrative Law Judge, in that case, to consider a pleading which was timely filed but not properly associated with the case file required reversal of the ALJ's decision granting an additional two-way channel to a DPLMRS licensee. The accuracy of the applicant's traffic loading data was a material issue, and the misfiled pleading disputed the applicant's data. According to the Commission, the failure to consider the misfiled pleading could not be considered "harmless error." Similarly, here, the failure to consider the experimental test results was highly prejudicial to SCI.

technology. If, in fact, the Commission's intention is to reward innovators, it cannot find better examples than Martin Cooper and Dr. Roy who have devoted their lives to developing dramatic new technologies with substantial public interest benefits.

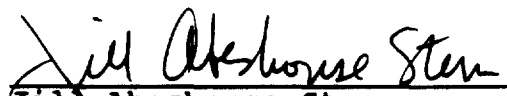
The record should be re-opened, if and as necessary, for purposes of evaluating SCI's preference request in light of this "new" information. This additional evidence of SDMA's technical feasibility, in addition to other compelling information on file, requires reversal of the Commission's decision, and grant of a well-deserved preference to SCI and its principals for their pioneering work in developing SDMA.

V.
CONCLUSION

For the reasons set forth herein, the Commission should reverse its previous decision, and grant a pioneer's preference to SCI for its innovative work in developing SDMA technology.

Respectfully submitted,
SPATIAL COMMUNICATIONS, INC.

By:


Jill Abeshouse Stern
Jennifer Clasby
SHAW, PITTMAN, POTTS & TROWBRIDGE
2300 N Street, N.W.
Washington, DC 20037
202-663-8380

Its Attorneys

March 30, 1994

DECLARATION

I, Dr. Richard Roy, do hereby declare as follows:

1. I have a Ph.D. in Electrical Engineering from Stanford University.
2. I am presently Chief Scientist of Spatial Communications, Inc. and President and Chief Technical Officer of ArrayComm, Inc.
3. I am the lead developer of a proprietary advanced spectrum access management technology known as Spatial Division Multiple Access ("SDMA").
4. I have either prepared or reviewed the technical information contained in the foregoing petition for reconsideration of the application of Spatial Communications, Inc. for a Pioneer's Preference in the Licensing Process for Personal Communications Services, and all the attachments thereto.
5. The technical facts contained in the above mentioned documents are accurate to the best of my knowledge and belief.

Under the penalties of perjury, the foregoing is true and correct.

30 March 1994

Date

Richard Roy

Dr. Richard H. Roy

DECLARATION

I, Dr. Richard Roy, do hereby declare as follows:

1. I have a Ph.D. in Electrical Engineering from Stanford University.
2. I am presently Chief Scientist of Spatial Communications, Inc. and President and Chief Technical Officer of ArrayComm, Inc.
3. I am the lead developer of a proprietary advanced spectrum access management technology known as Spatial Division Multiple Access ("SDMA").
4. I have either prepared or reviewed the technical information contained in the foregoing petition for reconsideration of the application of Spatial Communications, Inc. for a Pioneer's Preference in the Licensing Process for Personal Communications Services, and all the attachments thereto.
5. The technical facts contained in the above mentioned documents are accurate to the best of my knowledge and belief.

Under the penalties of perjury, the foregoing is true and correct.

30 March 1994

Date

Richard Roy

Dr. Richard H. Roy



EXHIBIT A

AFFIDAVIT

I, Dennis M. Rucker do hereby declare as follows:

1. This testimony is being provided solely for the purpose of being used in conjunction with ArrayComm's pending FCC filing, and in no other instance.
2. I am currently Director of Engineering for the United States Cellular Corporation, and have currently held my position for nine (9) months.
3. I am a duly qualified engineer, whose qualifications are a matter of record before the Federal Communications Commission. I hold the following degrees:

BSEE, Purdue, 1972

I have more than 22 years of experience in the design and development of telecommunications systems. Previous positions include the following:

Senior Director, Science & Technology, Ameritech Cellular

4. In my current position, I am responsible for supervising the design and installation of cellular telecommunications networks on a nationwide basis.
5. In my capacity as Director of Engineering, I have fully reviewed the theoretical and practical basics of ArrayComm's SDMA technology and witnessed a video taped demonstration thereof, and will be participating in a field demonstration.
6. On the basis of my review of the relevant literature and first-hand observations, it is my expert opinion the ArrayComm's SDMA is technically feasible and represents a truly innovative approach to increasing spectral efficiency. Deployment of SDMA technology will substantially reduce the amount of radiated (RF) power (over current technologies) required, per link, to establish reliable communication through directional transmission from and directional transmission by base stations, and will allow multiple wireless links to share the same spectrum in the same cell. The benefits include lower power handsets and base station RF transmissions, and a substantial increase in spectral efficiency. In the context of PCS, deployment of SDMA technology will facilitate more efficient use of available spectrum for all service providers, in addition, to alleviating some of the OFS coexistence issues by substantially reducing contemplated exclusion zones.

Under penalty of perjury, the following is true and correct to the best of my knowledge.

US Cellular Corporation

Name Dennis M. Rucker

Sign 

Title Director of Engineering

Date March 28, 1994

AFFIDAVIT

I, George D. Geotsalitis do hereby declare as follows:

1. This testimony is being provided solely for the purpose of being used in conjunction with ArrayComm's pending FCC filing, and in no other instance.
2. I am currently Manager of PCS Standards for the United States Cellular Corporation, and have currently held my position for four (4) months.
3. I have more than 22 years of experience in the design and development of telecommunications systems. Previous positions include the following:

Assistant Director, Standards, Ameritech Cellular
Manager, Instruction/Development, Bellcore
Manager, Transmission Engineering, Illinois Bell
Manager, Technical Planning, Illinois Bell

4. In my current position, I am responsible for participation in the development of standards for PCS.
5. In my capacity as Manager PCS Standards, I have fully reviewed the theoretical and practical basics of ArrayComm's SDMA technology and witnessed a field demonstration thereof.
6. On the basis of my review of the relevant literature and first-hand observations, it is my expert opinion the ArrayComm's SDMA is technically feasible and represents a truly innovative approach to increasing spectral efficiency. Deployment of SDMA technology will substantially reduce the amount of radiated (RF) power (over current technologies) required, per link, to establish reliable communication through directional transmission from and directional transmission by base stations, and will allow multiple wireless links to share the same spectrum in the same cell. The benefits include lower power handsets and base station RF transmissions, and a substantial increase in spectral efficiency. In the context of PCS, deployment of SDMA technology will facilitate more efficient use of available spectrum for all service providers, in addition, to alleviating some of the OFS coexistence issues by substantially reducing contemplated exclusion zones.

Under penalty of perjury, the following is true and correct to the best of my knowledge.

US Cellular Corporation

Name George D. Geotsalitis

Sign 

Title Manager, PCS Standards

Date March 28, 1994

AFFIDAVIT

I, Stuart Jeffery do hereby declare as follows:

1. I am currently Vice President of Kycom, and have held my current position for over one year.
2. I am a duly qualified engineer, whose qualifications are a matter of record before the Federal Communications Commission. I hold the following degrees:

BS Physics, Ohio State University
Graduate Studies in Electrical Engineering, University of Colorado.
Executive MBA, Northeastern University

I hold a First Class FCC Radiotelephone License.

I have more than 25 years experience in the design and development of telecommunications systems. Previous positions include the following:

Director of Network Systems, GTE Corporation, Waltham, MA.
Director of EW Systems, GTE Corporation, Mt View, CA.
Manager of ESM Systems, ERA, a division of E-Systems, Reston, VA.
Research Physicist, NBS, Boulder, CO.
Assistant Chief Engineer, Ohio State University Telecommunications Center, Columbus, OH.

3. In my current position, I am responsible for supervising the design and development of Kycom's PCS telecommunications network.
4. In my capacity as Vice President of Kycom, I have fully reviewed the theoretical and practical bases of ArrayComm's SDMA technology and witnessed field demonstrations thereof.
5. On the basis of my review of the relevant literature and first-hand observations, it is my expert opinion that ArrayComm's SDMA technology is technically feasible and represents a truly innovative approach to increasing spectral efficiency. Deployment of SDMA technology will substantially reduce the amount of radiated (RF) power (over current technologies) required per link to establish reliable communication through directional transmission from and directional reception by base stations, and will allow multiple wireless links to share the same spectrum in the same cell. The benefits include lower power handset and base station RF transmissions, and a substantial increase in spectral efficiency. In the context of PCS, deployment of SDMA technology will facilitate more efficient use of available spectrum for all service providers, in addition to alleviating some of the OFS coexistence issues by substantially reducing contemplated exclusion zones.

Under penalty of perjury, the foregoing is true and correct to the best of my knowledge.

Kycom

Name Stuart S. Jeffery

Sign 

Title Vice President of Engineering, Kycom

Date March 29, 1994

AFFIDAVIT

I, Guy Jouannelle do hereby declare as follows:

1. I am currently Senior Engineer of LCC LLC and have held my current position for 1 year.
2. I have more than 11 years experience in the design and development of telecommunications systems.

Previous positions include the following:

- Research Engineer of ONERA (France), responsible for antennas arrays conception, design and experimentation, and propagation modeling,
- Project Manager at Alcatel Radiotelephone (France), for radio engineering tool development,
- Director of Technical Development at France Telecom, responsible for all technical aspects of a GSM National Network Radio Engineering and Deployment.

3. In my current position, I am responsible for supervising PCS technologies trends analysis and associated radio engineering tools development.
4. In my capacity as Senior Engineer of LCC, I have reviewed theoretical and practical bases of ArrayComm's SDMA technology and witnessed field demonstrations thereof.
5. On the basis of my review of the relevant literature and observations, it is my expert opinion that ArrayComm's SDMA technology is technically feasible and represents a truly innovative approach to increasing spectral efficiency. Deployment of SDMA technology will substantially reduce the amount of radiated (RF) power (over current technologies and for the same cell size) required per link to establish reliable communications through directional transmission from and directional reception by base stations, and will allow multiple wireless links to share the same spectrum in the same cell. The benefits include lower power handset and base station RF transmissions, and a substantial increase in spectral efficiency. In the context of PCS, deployment of SDMA technology will facilitate more efficient use of available spectrum for all service providers.

Under penalty of perjury, the foregoing is true and correct to the best of my knowledge.

LCC LLC

Name : Guy Jouannelle

Sign



Title : Senior Engineer

Date : 30 March, 1994



EXHIBIT B

RECEIVED

MAY - 4 1992

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

Federal Communications Commission
Office of the Secretary

In the Matter of)

Request of Spatial Communications, Inc.)
for a Pioneer's Preference In the)
Licensing Process for Personal)
Communications Services)

PP No. 73

In the Matter of)

Amendment of the Commission's Rules)
To Establish New)
Personal Communications Services)

Gen. Docket No. 90-314

To: The Commission

REQUEST FOR PIONEER'S PREFERENCE OF
SPATIAL COMMUNICATIONS, INC.

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Its Attorneys

Walter H. Sonnenfeldt,
Policy Consultant

May 4, 1992

SUMMARY

Spatial Communications, Incorporated ("SCI"), pursuant to Section 1.402 of the Commission's Rules, hereby requests a Pioneer's Preference in the licensing process for Personal Communications Services ("PCS") in General Docket No. 90-314. This request is premised on SCI's plan to provide PCS using a dramatic new technology, Spatial-Division Multiple Access ("SDMA"), developed and patented by principals of SCI.

SCI's SDMA technology makes possible for the first time dynamic real-time exploitation of the spatial dimension in the mobile personal communications system spectral utilization scheme. SDMA technology is fully compatible with all current Frequency-Division Multiple Access ("FDMA"), Time-Division Multiple Access ("TDMA"), and Code-Division Multiple Access ("CDMA") frequency management technologies.

SCI's PCS SDMA technology will yield increases in PCS system spectral efficiency as high as a factor of ten, in addition to efficiencies afforded by use of FDMA, TDMA, and CDMA. The ability of SDMA-equipped PCS systems to dynamically control the direction and power level (effective distance) of signal transmissions will also result in significant improvements in PCS signal quality. Additionally, initiating PCS with SDMA will reduce the costs of implementing PCS, and maximize dynamic spectrum sharing between PCS systems and existing users in other services. Incorporating the SDMA spectral management technique in the PCS regulatory framework will also expand the Commission's PCS licensing options by increasing the effective capacity of PCS spectrum allocations.

In sum, integrating SDMA with PCS will:

- Significantly increase the effective channel capacity of PCS base stations;
- Significantly increase the quality of communications links;
- Significantly reduce the required amount of transmitted power from both base stations and mobile units;
- Lower the overall system cost by reducing the number of base stations required to handle a given system load;
- Significantly increase flexibility in system architecture;
- Significantly reduce or completely eliminate harmful interference to and from existing primary services resulting from co-primary PCS system operations; and
- Facilitate extremely precise position determination capabilities in a PCS system with no significant increase in deployment cost.

* * * * *

A rigorous series of tests confirming the precise accuracy and flexible operation of SCI's prototype SDMA system, documented in Appendix A hereto, conclusively demonstrate the feasibility of PCS SDMA technology. In addition, cost/benefit analyses presented by SCI demonstrate the economic feasibility of implementing PCS SDMA and attendant PCS system profitability increases that will result.

The pioneering accomplishments of SCI, and its principals, in the development of PCS SDMA technology, and the revolutionary enhancements in spectral efficiency, service quality, system design flexibility, and co-primary sharing capability resulting therefrom clearly meet the Commission's rigorous qualification standards for

grant of a Pioneer's Preference. Accordingly, the Commission should award SCI a Pioneer's Preference in connection with the PCS rulemaking proceedings in General Docket No. 90-314.

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RECEIVED

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

MAY - 4 1992

Federal Communications Commission
Office of the Secretary

In the Matter of)

Request of Spatial Communications, Inc.)
for a Pioneer's Preference In the)
Licensing Process for Personal)
Communications Services)

PP No. _____

In the Matter of)

Amendment of the Commission's Rules)
To Establish New)
Personal Communications Services)

Gen. Docket No. 90-314

To: The Commission

REQUEST FOR PIONEER'S PREFERENCE

Spatial Communications, Incorporated ("SCI"), pursuant to Section 1.402 of the Commission's Rules, hereby requests a Pioneer's Preference in the licensing process for Personal Communications Services ("PCS") in General Docket No. 90-314.^y This request is premised on SCI's plan to provide PCS using a dramatic new technology, Spatial-Division Multiple Access ("SDMA"), developed and patented by principals of SCI.

^y 47 CFR §1.402. See also, Establishment of Procedures to Provide a Preference to Applicants Proposing an Allocation for New Services, 6 FCC Rcd 3488 (1991) ("Pioneer's Preference Order"), recon., FCC 92-57, released February 26, 1992 ("Pioneer's Preference Reconsideration Order"). Submission of the instant request complies with the Commission's PCS pioneer's preference request filing deadline in Gen. Docket No. 90-314. See FCC Public Notice No. 22536, released April 3, 1992.

SCI's SDMA technology makes possible for the first time dynamic real-time exploitation of the spatial dimension in the mobile personal communications system spectral utilization scheme. As demonstrated fully below and in Appendix A hereto, application of SCI's PCS SDMA technology will yield increases in the spectral efficiency of PCS systems as high as a factor of ten. The ability of SDMA-equipped PCS systems to dynamically control the direction and power level (effective distance) of signal transmissions will also result in significant improvements in PCS signal quality. Additionally, initiating PCS with SDMA will reduce the costs of implementing PCS, and maximize dynamic spectrum sharing between PCS systems and existing users in other services. SDMA technology is fully compatible with all current Frequency-Division Multiple Access ("FDMA"), Time-Division Multiple Access ("TDMA"), and Code-Division Multiple Access ("CDMA") frequency management technologies, and can be readily employed in PCS systems utilizing these techniques. Incorporating the SDMA spectral management technique in the Commission's PCS regulatory framework will expand the range of PCS licensing options by increasing the effective capacity of PCS spectrum allocations. SDMA technology will profoundly improve the design and operation of PCS systems and should be an integral component of the Commission's PCS regulatory framework.

The pioneering accomplishments of SCI, and its principals, in the development of PCS SDMA technology, and the revolutionary enhancements in spectral efficiency, service quality, system design

flexibility, and co-primary sharing capability resulting therefrom, clearly meet the Commission's rigorous qualification standards for grant of a Pioneer's Preference. Accordingly, the Commission should award SCI a Pioneer's Preference in connection with the PCS rulemaking proceedings in General Docket No. 90-314.

I. BACKGROUND

SCI is a Delaware corporation, formed to develop and commercialize a full-range of PCS technologies. A central focus of SCI's PCS commercialization efforts is application of proprietary SDMA spectral management technology to operating PCS systems. One World Telecommunications, Inc. ("OWT"), a major shareholder of Spatial Communications JV, Inc., SCI's parent company, is a leader in the development and marketplace implementation of state-of-the-art PCS microcellular technologies. Key principals of OWT, who have been involved in cellular communications since 1983, and in PCS technology development since 1990, also serve as officers and directors of SCI. Dr. Richard Roy, the lead inventor of SDMA technology, serves both as a director and as Chief Scientist of SCI.¹ Other members of the SDMA development team serve as SCI's Principal Engineer and Science Advisor. SCI's corporate resume is attached hereto as Appendix B.

¹ Dr. Roy is also a Research Associate at Stanford University in Palo Alto, California.

II. DESCRIPTION OF PCS SDMA TECHNOLOGY

SDMA is a pioneering frequency access technology, developed over a fifteen-year period and patented by principals of SCI. Essentially, SDMA involves dynamic, real-time utilization of the spatial dimension in the frequency assignment process of wireless mobile communications systems. SDMA is particularly well-suited to application in the PCS operating environment.

Simple, low-cost multiple antenna arrays, advanced high-speed special purpose digital real-time signal processing hardware, and customized SDMA network control software comprise the essential components of an SDMA system. Base stations in a PCS system employing SDMA can manage multiple, simultaneous co-channel transactions within their individual service area (i.e., cell or cell sector). SDMA technology exploits the spatial dimension in the frequency assignment process by dividing the coverage area of a PCS base station antenna into angular transmission sectors ("spatial channels"). An SDMA signal processor can assign spatial channels on a real-time basis for use in a PCS system. Dynamic real-time spatial management of spectrum utilization either in an entire PCS system or in selected cells can be achieved by interconnecting base stations equipped with SDMA antenna arrays to a central SDMA network control facility.

Incorporating SDMA technology in a PCS system architecture will dramatically increase spectral efficiency and signal quality, while allowing PCS systems to operate on a co-primary basis with